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<p>(21) International Application Number: PCT/AU98/00316 (22) International Filing Date: 30 April 1998 (30.04.98) (30) Priority Data: PO 6500 30 April 1997 (30.04.97) AU (71) Applicant (for all designated States except US): WEEKS PEACOCK QUALITY HOMES PTY. LTD. [AU/AU]; 712-714 South Road, Glandore, S.A. 5073 (AU). (72) Inventor; and (75) Inventor/Applicant (for US only): WEEKS, Kevin, William [AU/AU]; 712-714 South Road, Glandore, S.A. 5073 (AU). (74) Agent: PIZZEYS PATENT AND TRADE MARK ATTOR- NEYS; Level 6, Trustee House, 444 Queen Street, Brisbane, QLD 4000 (AU).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report.</p>
<p>(54) Title: A STRUCTURAL MEMBER</p> <p>(57) Abstract</p> <p>The present invention relates to a structural member (10) for the use as a chord (41, 42) for forming a roof truss (40) for a building. The invention in one aspect broadly resides in an elongated open structural (10) member having a cross section including a minor flange (12), a major flange (13), and a web (14) interconnecting said flanges and having a section axis (11a) at right angle to the longitudinal axis (11b) of the structural member (10) and passing through the flanges (12, 13) and wherein said web (14) includes a linear portion (17) substantially coincident with the section axis (11a) and a divergent portion (18) which extends to one side of said section axis (11a); said minor flange (12) extends to said one side of said section axis (11a); said major flange (13) extends from said divergent portion (18) to the opposite side of said section axis (11a), and the section configuration being such that an inverted and reversed corresponding open member is nestable within said open structural member (10) with their respective linear section portions (17) alongside one another and with each minor flange (12) located in an abutting relationship against the underside of the adjacent major flange (13).</p>		

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## A STRUCTURAL MEMBER

## FIELD OF THE INVENTION

The invention relates to a structural member for construction of buildings such as houses. The invention has particular but not exclusive application in use as a chord for forming a roof truss for a building.

## PRIOR ART

A metal roof truss is commonly constructed with box-section chords and C-section web members. The box-section chords are formed by two C-sections individually roll formed and then further fabricated by dimple formation for locating and/or fastening by welding, riveting, hole punched and bolted or screwed to close the two C-sections. The fabrication of the section is a specialised operation and adds additional cost and time to the manufacture of a chord.

Open sections are generally quicker and cheaper to manufacture than box-sections comprising two C-sections, but they lack the strength and stiffness required for chords. Thus, whenever open sections, such as channel and Z-sections are used in the fabrication of building frames and roof trusses, additional precautions such as providing oversized sections or additional structural support must be taken to compensate for their inherent strength deficiencies.

This of course increases the cost of many structures formed therefrom.

In addition, effecting the joints between top and bottom chords and between web members and chords mostly  
5 requires specialised joining members or shaping for welding which adds to the cost and complexity of such structures.

#### SUMMARY OF THE INVENTION

It is an object of this invention to provide an  
10 alternative structural member suitable for forming the chord of a truss or other structural member.

In one aspect the invention broadly resides in an elongated open structural member having a cross-section including a minor flange, a major flange and a web  
15 interconnecting said flanges and having a section axis at right angles to the longitudinal axis of the structural member and passing through the flanges and wherein:-

said web includes a linear portion substantially  
20 coincident with the section axis and a divergent portion which extends to one side of said section axis;

said minor flange extends to said one side of said section axis;

said major flange extends from said divergent  
25 portion to the opposite side of said section axis, and

the section configuration being such that an inverted and reversed corresponding open structural

member is nestable within said open structural member with their respective linear section portions alongside one another and with each minor flange located in an abutting relationship against the underside of the adjacent major flange.

The linear portion may be any suitable length but preferably the linear portion is extends along a major portion of the section axis between the flanges. The term "suitable" is qualified by the particular use of the open structural member and where a corresponding member is used the length of the linear portion [must] suitably enables overlap of the linear section portions or portions thereof.

The divergent portion may have any suitable shape. The divergent portion may be curved, straight, or comprise a series of straight segments. In a preferred embodiment the divergent portion is a single straight portion and the major flange extends at an acute angle from the divergent portion.

The linear portion connects to the minor flange at its end opposite the divergent portion. Preferably the minor flange extends from the linear portion at an angle of substantially 90 degrees. Alternatively, the linear portion may include a second divergent portion which extends to the minor flange. The second divergent portion may be curved, straight, or comprise a series of straight segments.

The minor flange is preferably shorter than the major flange and most preferably is shorter than the section of the major flange which extends between the section axis and the end of the major flange remote from the divergent portion, and hereinafter referred to as its "free edge". Preferably the intersection with the section axis occurs about midway across the major flange.

Preferably the flanges are substantially flat or at least parts which are substantially diagonally opposite with respect to the section axis are substantially flat. Preferably the flanges or at least the flat parts are substantially parallel.

Preferably the open structural member includes limiting means to restrict lateral movement with respect to the section axis of connected members along the section axis. Preferably the limiting means is a return flange extending along the free edge of the major flange.

The major and/or the minor flanges preferably both terminate in a return flange. The return flange preferably returns substantially parallel to the section axis. Preferably the return flange of the major flange is spaced further from the section axis than the free edge of the minor flange so that a reversed and inverted corresponding open structural member may nest within the structural member.

The open structural member is preferably

asymmetrical in shape and allows the nesting of an inverted and reversed corresponding open structural member with the minor flange of one open structural member locatable within the major flange of the other open structural member and overlapping of the linear section portions.

The invention in a further aspect broadly resides in an elongated open structural member having a minor flange, a major flange and a web interconnecting said flanges and having a planar web portion extending at right angles to the minor and major flanges, and wherein:-

said web includes a divergent portion which extends to one side of said planar portion;

said minor flange extends to said one side of said planar portion;

said major flange extends from said divergent portion to the opposite side of said planar portion;

said minor flange and said major flange each have a return along their respective free edge, and wherein

the configuration being such that an inverted and reversed corresponding open structural member is locatable with its planar portion alongside the planar portion of said structural member and each minor flange including its return being locatable within the confine defined by the adjacent return flange of the major flange.

In another aspect the invention resides in a chord



member for a truss, each chord member of the truss being an open structural member as described above whereby the chord member may be disposed with its major flange outermost and with interconnections between intersecting chord members being made by extending the web and minor flange of one intersecting chord member across the web and minor flange of the other chord member with the webs overlying one another enabling through fastening together. In such arrangement the webs overlap at joints for connection to one another such as by bolting or screwing or welding and, if desired disposed with their minor flanges nested within the major flanges of the opposing chord member.

It is also preferred that the chords of said truss are interconnected by truss members which may be open section members suitably terminated for web to web connection to the webs of the top and bottom chord members.

The assembled truss with the open structural member forming the top and bottom chord members with C-section truss members preferably has the chord members proud of the truss members thereby allowing stacking of the assembled truss and transportation of the stacks without risk of damage to the truss members by the overlying chord members. In contrast conventional box section chords have C-section truss members joined at their flat surfaces thereby causing the truss members to be proud of the chord members and exposing the truss

members to damage during stacking and their transportation.

In a further aspect the invention broadly resides in a composite beam formed by the nesting of two open structural members as described variously above in an inverted and reversed orientation with respect to each other with the minor flange of one member located within the major flange of the other member and overlapping of the planar portions and fastening means connecting the open structural members together.

The open structural members may be prevented from lateral displacement with respect to one another by the fastening means but preferably they include returns along the free edges of the major flanges which restrain lateral displacement of the open structural members with respect to one another.

Preferably the nesting of the open structural members as described above forms two closed sections thereby providing strength to the beam.

## BRIEF DESCRIPTION OF THE DRAWINGS

Several typical embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

- FIG. 1 is an end elevation of an elongate open structural member;
- FIG. 2, 3, 4 are perspective views of the member;
- FIG. 5 is an end elevation of two members nested

in reverse and inverted orientation with respect to each other;

FIG. 6a is a front elevation of an assembled truss with open structural members as top and bottom chord members;

FIG. 6b-g shows various connections on the truss shown in Fig. 6a;

FIG. 7a-c are views of the interconnection of two open structural members;

FIG. 8a-c are views of different attachments of a C-section truss members to a chord;

FIG. 9a-c show alternative connections between chords and truss members; and

FIG. 10 shows an alternative structural member.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to Figs. 1, 2, 3 and 4 there is shown an elongate open structural member 10 having a minor flange 12 and a major flange 13 separated by a web 14. A longitudinal axis 11b of the member 10 is shown in Fig 2. The web 14 includes a planar portion 17 and a divergent portion 18. A section axis 11a is coincident with the linear portion 17.

The minor flange 12 extends from the planar portion 17 at 90 degrees. The minor flange 12 includes a return flange 15. The return flange 15 is parallel to the section axis 11a.

The divergent portion 18 diverges from the section

axis 11a at an acute included angle indicated by  $\alpha$ .  
The divergent portion 18 is connected to the major  
flange 13. The major flange 13 includes a broad planar  
flange portion 19 which is connected to the divergent  
5 portion 18 forming an acute included angle. The major  
flange 13 also includes a return flange 20 parallel to  
the section axis.

As shown in Fig. 5, two elongate open structural  
members 30, 31 as described above are able to be nested  
10 with one member being in reverse and inverted  
orientation with respect to the other. To effect  
nesting minor flanges 32a and 32b are located within  
major flanges 33b and 33a respectively in abutting  
relationship. In this position the respective web  
15 portions 34a, 34b partly overlies each other thereby  
allowing fasteners to join both members 30, 31 to  
prevent lateral movement. The abutting relationship of  
the respective flanges 32a, 32b, 33a, 33b prevents  
movement along the section axis. The nesting of the  
20 two elongate members forms two closed sections 35, 36  
which provide strength and stiffening to the composite  
member.

Roof trusses 40 as shown in Fig 6a-g are  
constructed with elongate open structural members  
25 forming top and bottom chords 41, 42 and C-section truss  
members. The connection of the top chord 41 to the  
bottom chord 42 is shown in fig. 6b. The major flanges  
44, 45 of the top and bottom chords 41 and 42

respectively are outermost. The minor flange 46 of the top chord 41 is partially located and confined in major flange 45. The rearward flat side 47 of top chord 41 partly overlaps frontward flat side 48 of the bottom chord 42. There is shown an intermediate connection plate 49 between sides 47 and 48. The connection plate 49 is attached to the bottom chord 42 by bolts 50, 51 and to the top chord 41 by bolts 50, 52. An alternative connection is shown in Fig. 9c where top chord 60 is bolted to bottom chord 61 at 62.

Connections of the truss members 43 to the chord members 41,42 is shown in Fig. 6c, 6d, 6f. In Fig. 6d the truss members 43 are crimped and joined to the top chord 41 by bolt 70. In Fig. 6e the truss members 43 are attached to the bottom chord 42 by bolt 72. The underlying truss members are at least crimped to accommodate the connection. The connection shown in Fig. 6c has the truss member 43 connected by bolt 71 to the bottom chord 42. The chords 41,42 are proud of the truss members 43 in the truss 40.

The apex 80 of the truss 40 is shown in Fig. 6f, 6g. An apex plate 81 serves to connect top chords 41 by bolts 82. The apex plate 81 has recessed ribs 83 to provide additional stiffening. The apex plate 81 also has a recess 84 for the location of a C-section truss member 43. The C-section truss member 43 is connected to the apex plate 81 by bolt 85. Alternative connections in an apex are shown in Fig. 9a and 9b. In

Fig. 9a top chords 63 and C-section truss members 64 are connected by bolt 65. Similarly in Fig. 9b the top chords 66 and C-section truss member 67 are connected by bolt 68.

5 In Fig. 7a-c there is shown chords 90,91 with major flanges 92,93 outermost and minor flange 94 located partially within the major flange 92.

In Fig. 8a-c there is shown attachment of crimped C-section truss members 95 to elongate open structural member chords 96 by bolts 97. The C-section truss member 95 has end 98 crimped presenting a flat surface 99 for connecting to the chord 96. The flat surface 99 is attached to the side of the web portion 100 opposite the narrow flange 101.

15 The embodiment described above provides a number of advantages including efficient roll forming for chord production; provision of a strengthened and stiffer open section member chord with proper orientation of the major flange outermost; the ability  
20 to treat or coat the entire chord or composite beam or truss having open sections prior to use; compact truss stacking with chords being proud of truss web members thereby minimising damage to the truss members during transportation and reducing transport and storage  
25 costs; the ability of the chords to overlap for interconnection while maintaining the overlapped chords in line one above the other for symmetry of the truss and to be easily fastened together at terminations.

It will of course be realised that while the foregoing has been given by way of illustrative example of this invention, all such and other modifications and variations thereto as would be apparent to persons  
5 skilled in the art are deemed to fall within the broad scope and ambit of this invention as is herein set forth.

## CLAIMS

1. An elongated open structural member having a cross-section including a minor flange, a major flange, and a web interconnecting said flanges and having a section axis at right angles to the longitudinal axis of the structural member and passing through the flanges and wherein:-

said web includes a linear portion substantially coincident with the section axis and a divergent portion which extends to one side of said section axis;

said minor flange extends to said one side of said section axis;

said major flange extends from said divergent portion to the opposite side of said section axis, and

- the section configuration being such that an inverted and reversed corresponding open member is nestable within said open structural member with their respective linear section portions alongside one another and with each minor flange located in an abutting relationship against the underside of the adjacent major flange.

2. An elongate open structural member as claimed in claim 1 wherein said linear portion extends along a major portion of the section axis between the flanges.



3. An elongate open structural member as claimed in claim 1 wherein said linear portion extends along a major portion of the section axis between the flanges and said major flange extends at an acute angle from  
5 the divergent portion.

4. An elongate open structural member as claimed in claim 1 wherein said minor flange is shorter than a section of the major flange which extends between the section axis and an end of the major flange remote from  
10 the divergent portion.

5. An open structural member as claimed in claim 1 wherein the flanges are substantially flat or at least parts which are substantially diagonally opposite with respect to the section axis are substantially flat.

15 6. An open structural member as claimed in claim 1 wherein the member includes limiting means to restrict lateral movement with respect to the section axis of connected members along the section axis.

20 7. An open structural member as claimed in claim 1 wherein the member includes limiting means to restrict lateral movement with respect to the section axis of connected members along the section axis and wherein said limiting means includes a return flange within the major flange.

8. An open structural member as claimed in claim 1 wherein the member includes limiting means to restrict lateral movement with respect to the section axis of connected members along the section axis and wherein  
5 said limiting means is a return flange extending along the free edge of the major flange.

9. An elongated open structural member having a cross-section including a minor flange, a major flange, and a web interconnecting said flanges and having a  
10 planar web portion extending at right angles to the minor and major flanges, and wherein:-

said web includes a divergent portion which extends to one side of said planar portion;

said minor flange extends to said one side of said  
15 planar portion;

said major flange extends from said divergent portion to the opposite side of said planar portion;

said minor flange and said major flange each have a return along their respective free edge, and wherein

20 the section configuration being such that an inverted and reversed corresponding open structural member is locatable with its planar portion alongside the planar portion of said open structural member and each minor flange including its return being locatable  
25 within the confines defined by the adjacent return flange of the major flange.

10. An open structural member as claimed in claim 9 wherein the minor flange is located in an abutting relationship against the underside of the adjacent major flange.

- 5 11. A chord member for a truss, wherein each chord member of the truss is an open structural member as claimed in claims 1 or 9 whereby the chord member may be disposed with its major flange outermost and with interconnections between intersecting chord members
- 10 being made by extending the web and minor flange of one intersecting chord member across the web and minor flange of the other chord member with the webs overlying one another enabling through fastening together.
- 15 12. A truss including chords formed by elongate open structural members as claimed in claim 1 or claim 9.
13. A truss including chords formed by elongate open structural members as claimed in claim 1 or claim 9 wherein the webs overlap at joints for connection to
- 20 one another and the minor flange of one of the members is partially confined and retained within the major flange of the other chord member.
14. A truss including chords formed by elongate open

structural members as claimed in claim 1 or claim 9 wherein the webs overlap at joints for connection to one another and the minor flange of one of the members is partially confined and retained within the major  
5 flange of the other chord member and wherein the members are connected by suitable fasteners at the their overlying web portions.

15. An apex plate connectable to top chords being elongate open structural members as claimed in claim 1  
10 or 9 and having a recess for connection to a truss member.

16. An assembled truss including chords of elongate open structural members as claimed in claims 1 or 9 and truss web members wherein the chords are proud of the  
15 truss web members.

17. A composite beam formed by the nesting of two open structural members as claimed in claim 1 or 9 in an inverted and reversed orientation with respect to each other with the minor flange of one member located  
20 within the major flange of the other member and overlapping of the planar portions and fastening means connecting the open structural members together.

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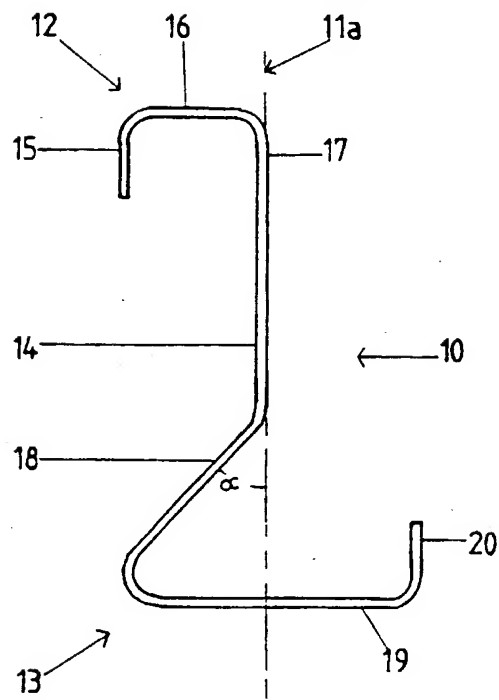


Fig.1

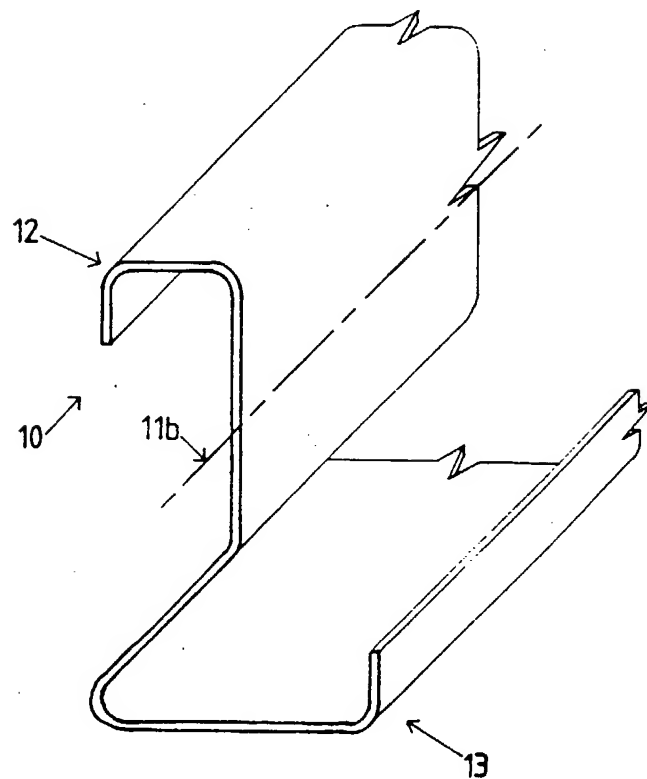
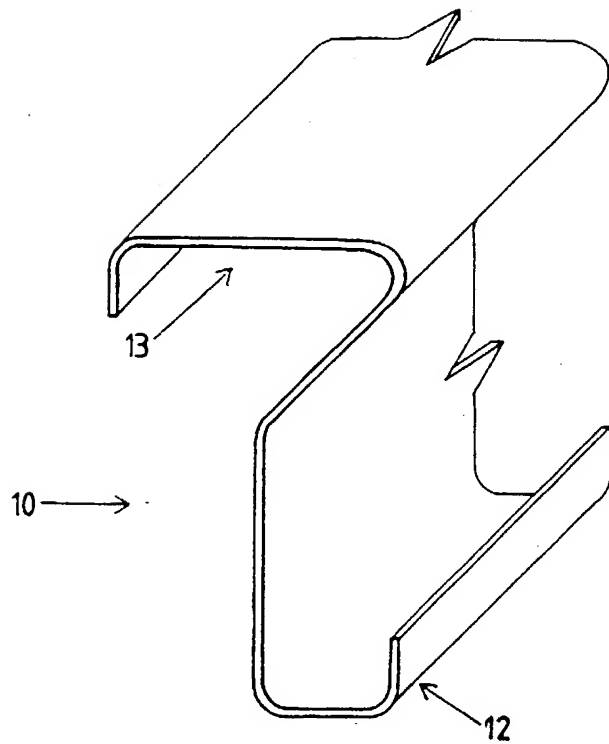
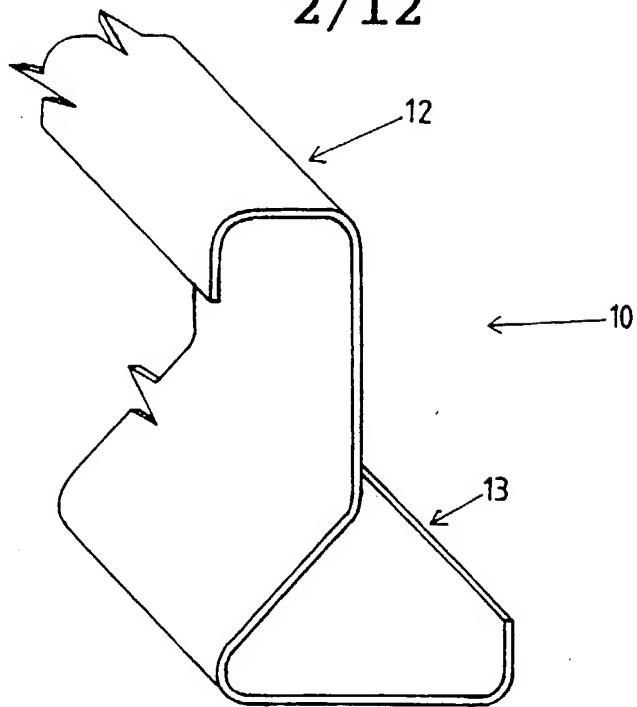


Fig.2

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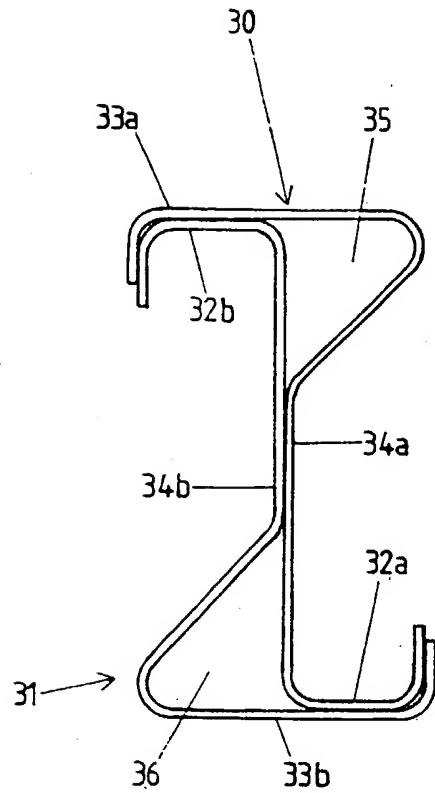


Fig.5

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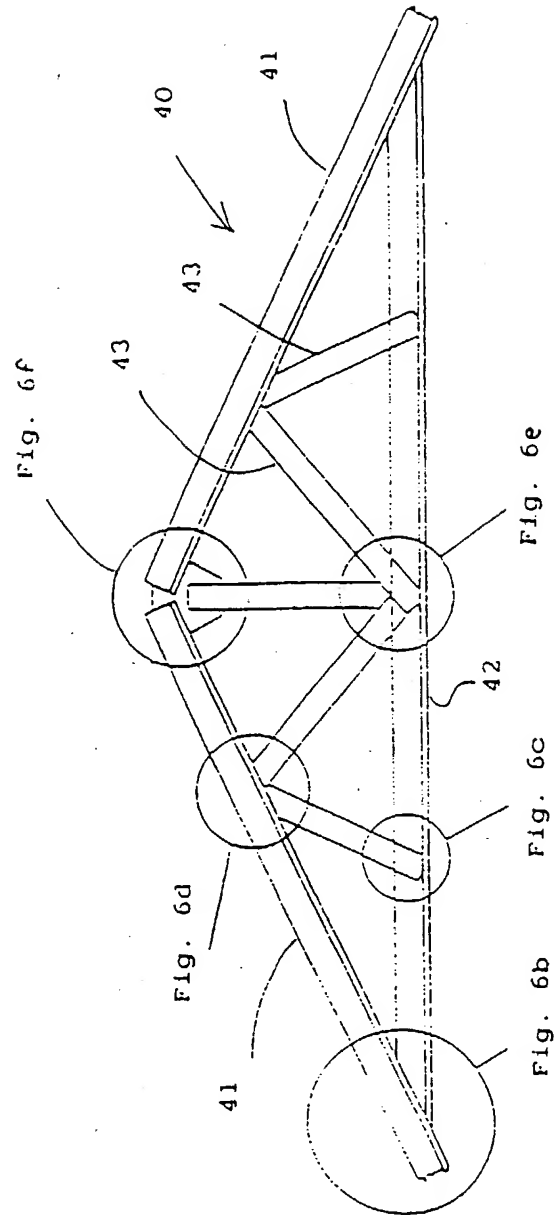
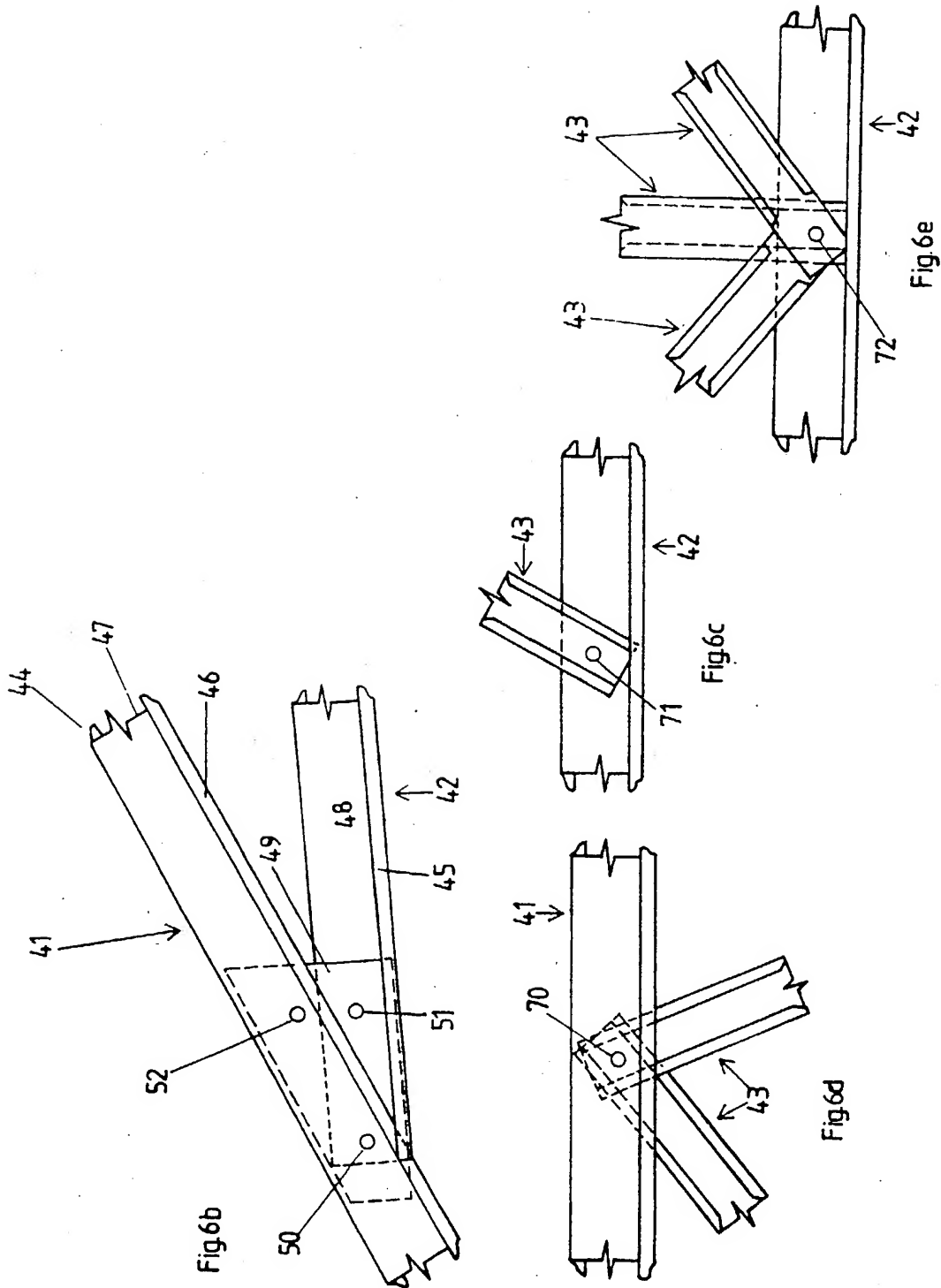


Fig. 6a



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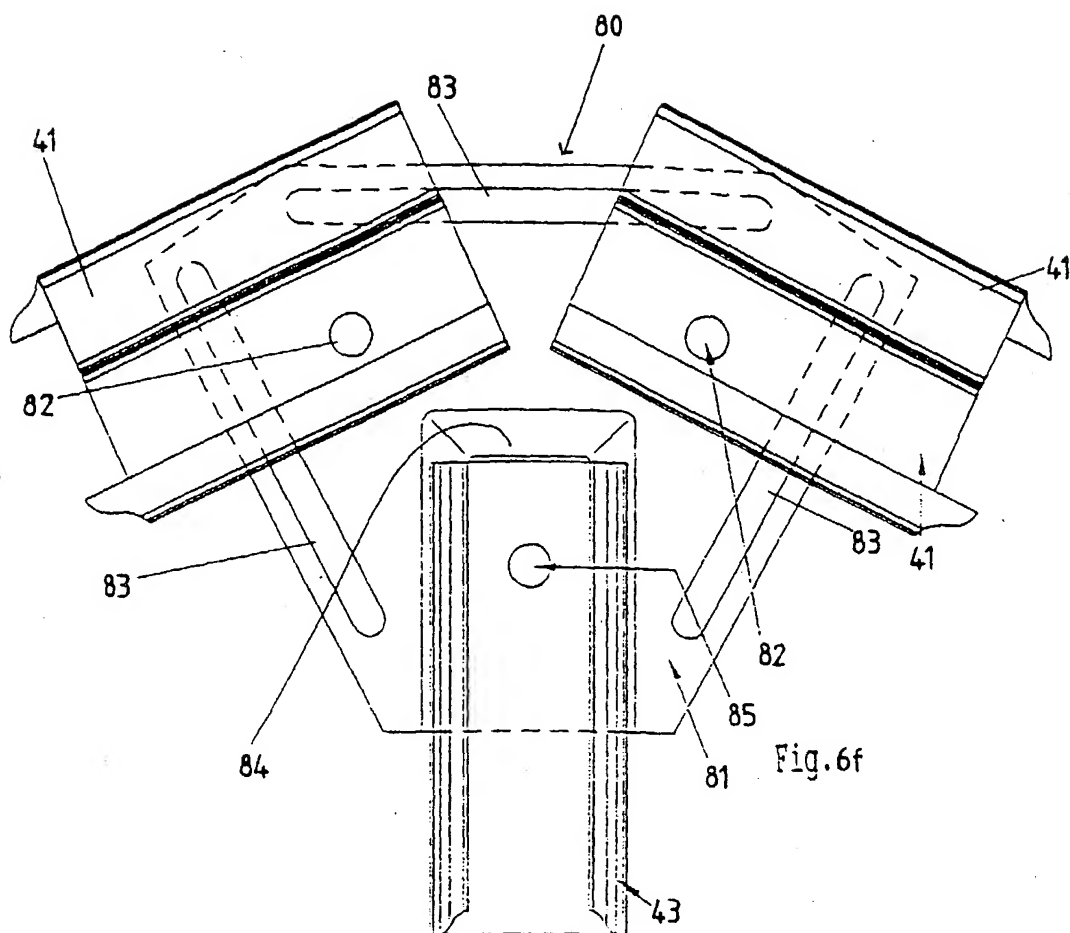


Fig. 6f

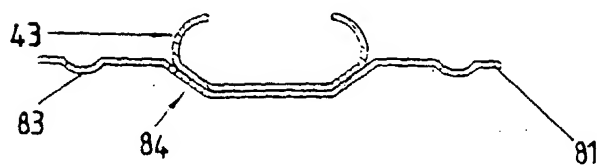
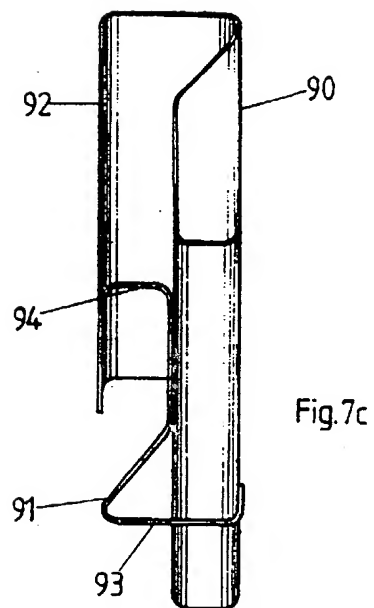
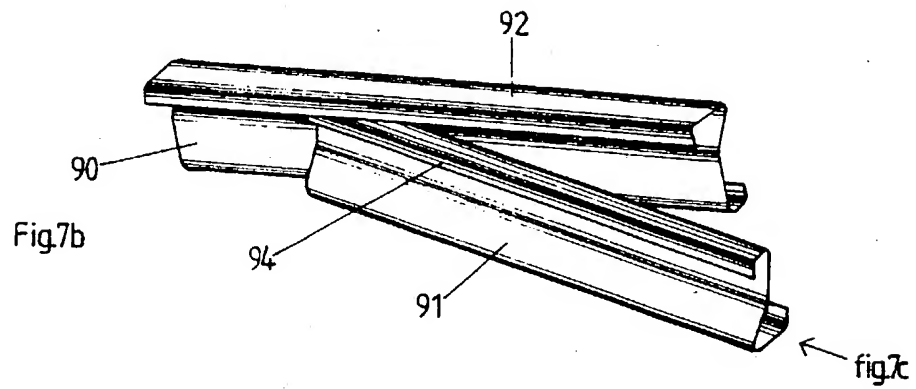
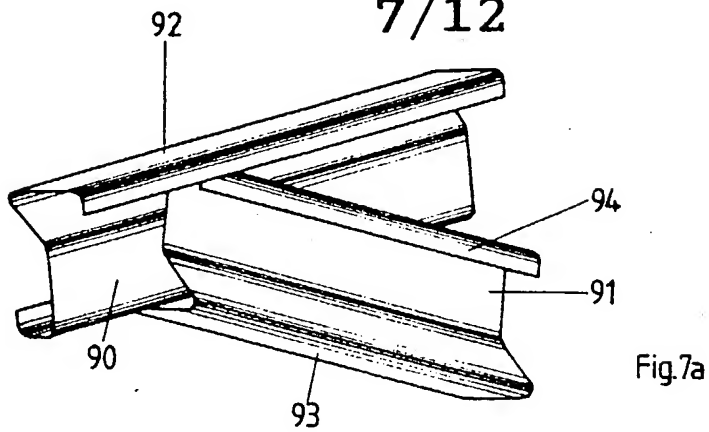


Fig. 6g

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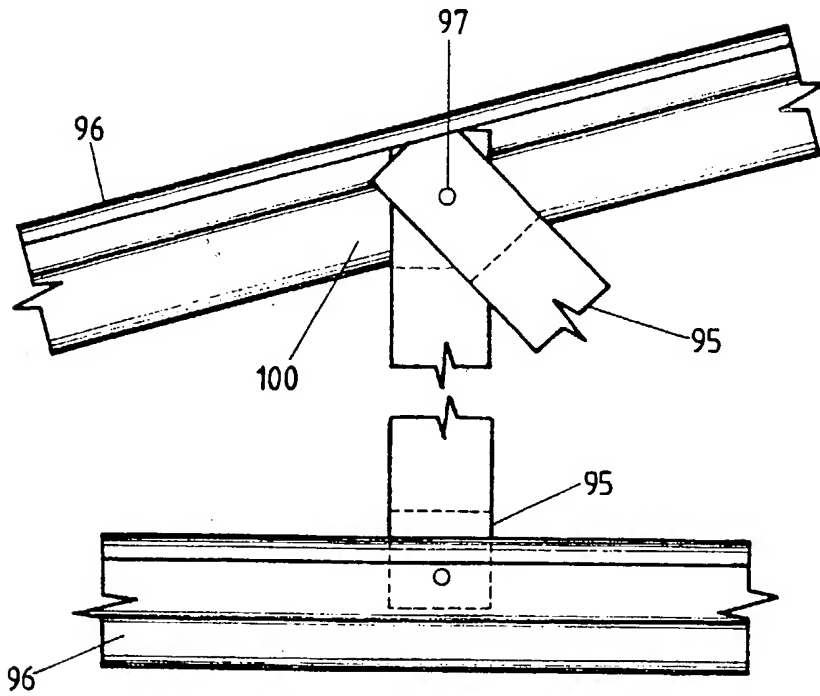


Fig. 8a

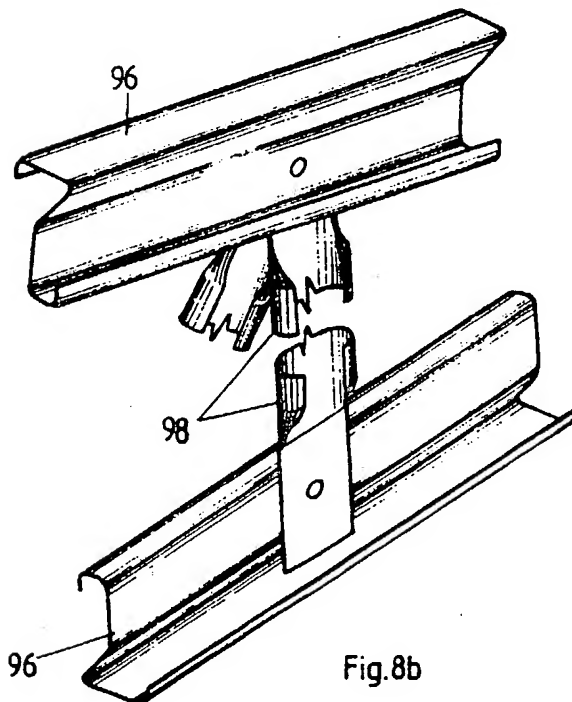


Fig. 8b

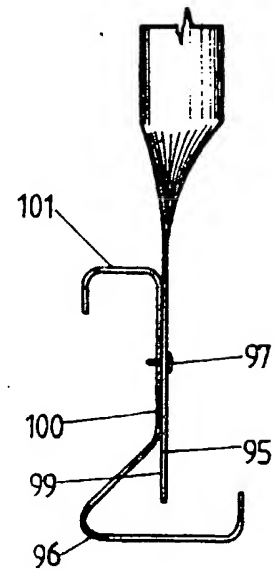


Fig. 8c

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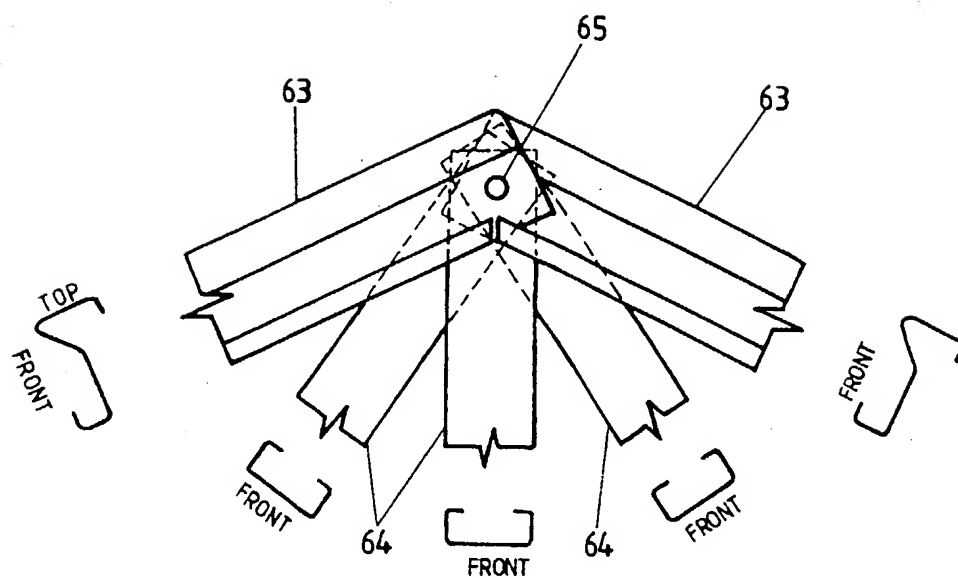


Fig.9a

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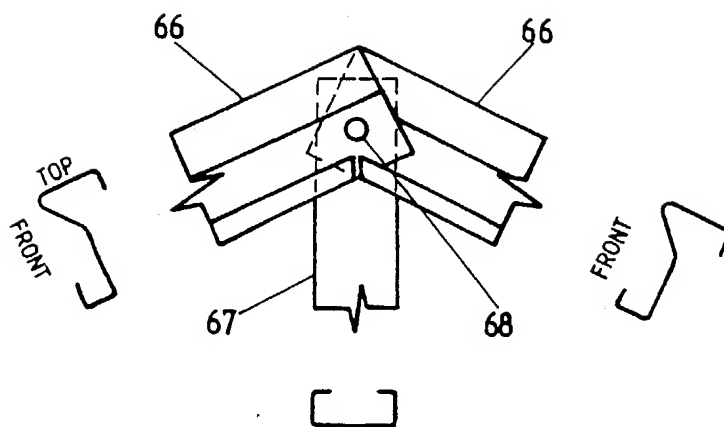


Fig. 9b

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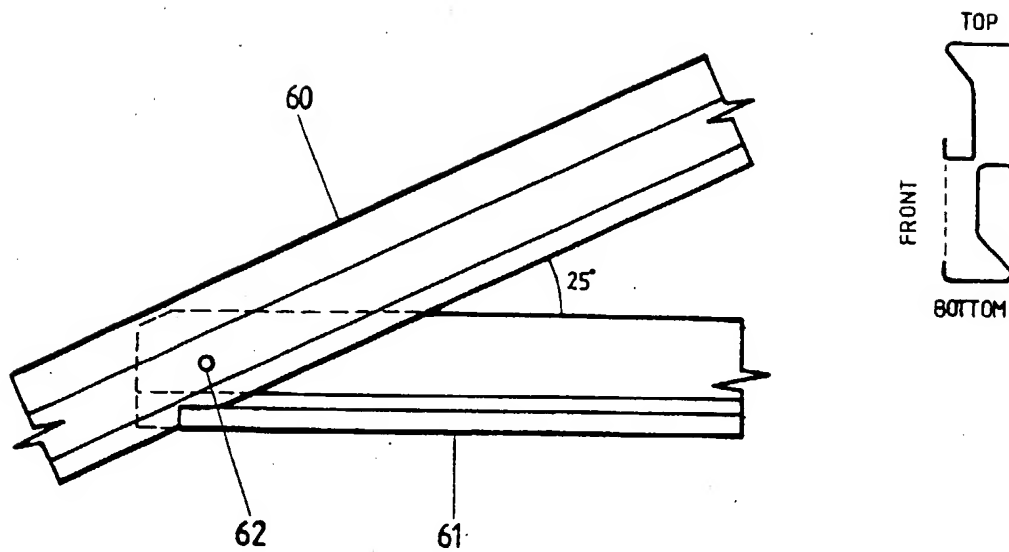


Fig. 9c

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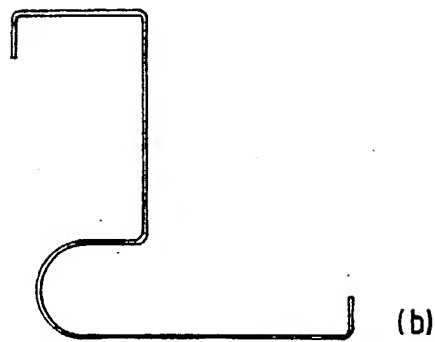
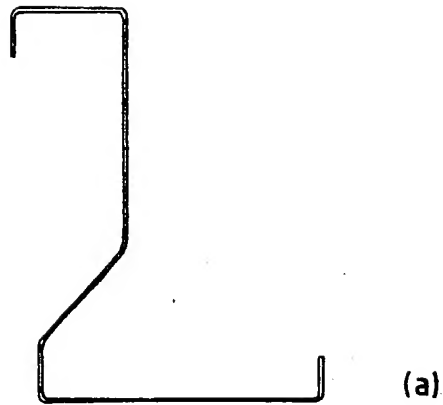
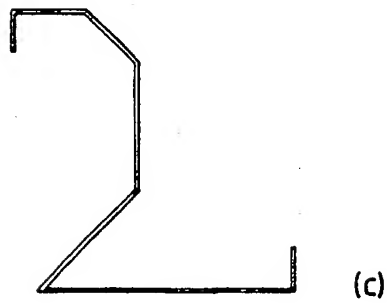


Fig.10





# INTERNATIONAL SEARCH REPORT

International Application No.  
PCT/AU 98/00316

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>												
Int Cl <sup>6</sup> : E04C 3/07												
According to International Patent Classification (IPC) or to both national classification and IPC												
<b>B. FIELDS SEARCHED</b>												
Minimum documentation searched (classification system followed by classification symbols) E04C 3/06, 3/07, 3/08, 3/09												
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU : IPC as above												
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) DERWENT, JAPIO : E04C 3/-, CHORD, SECTION, PURLIN, JOIST, STRUCTUR, CURV, DIVERG, ANGL, WEB, INTERMED, PORTION, SECTION, MEMBER												
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>												
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.										
X	EP 357930 A (KRUPP STAHL KALTFORM GmbH) 14 March 1990 See figure 1, 5	1-3, 5-6, 8-9										
X	GB 2062060 A (ANGLIA JAY PURLIN CO LTD) 20 May 1981 See figure 2	1-6, 8, 9										
X	FR 1137631 (GALANTE) 3 May 1957 See figure 4	1-6, 8										
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex												
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E" earlier document but published on or after the international filing date</td> <td>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&amp;" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E" earlier document but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention											
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art											
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family											
"P" document published prior to the international filing date but later than the priority date claimed												
Date of the actual completion of the international search 6 June 1998		Date of mailing of the international search report 14 JUL 1998										
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929		Authorized officer  B. BOURKE Telephone No.: (02) 6283 2148										

# INTERNATIONAL SEARCH REPORT

International Application No.

PCT/AU 98/00316

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 91/17328 A (NAVON) 14 November 1991 See figure 3, 4, 6	1-6, 8, 17
P,A	WO 97/28326 A (THE BROKEN HILL PLC) 7 August 1997 See figure 1	
A	WO 92/21913 (JOHN VINCENT MOORE (Consulting Engineers) PTY LTD) 10 December 1992 See figure 1	
A	AU 77540/94 A (MILNE) 1 June 1995 See figures 1-3	

## INTERNATIONAL SEARCH REPORT

### Information on patent family members

International Application No.

PCT/AU 98/00316

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
EP	357930	DE	3829719	FI	893759		
WO	91/17328	AU	79091/91	AU	12231/95	CA	2082530
		EP	528973	EP	649949	US	5553437
WO	97/28326	AU	15370/97				
WO	92/21913	AU	17760/92				
END OF ANNEX							